Stantec **Memo**

To:	Bill Lyle (Newmont Mining Company), Lou Miller (WME)	From:	Thomas Kelley (Stantec)
File:	250gpmWTP_WB_Rev0.docx	Date:	April 19, 2019

Reference: Revised water balance model results for Water Treatment Plant with capacity for 250 gpm continuous operation

This memorandum summarizes the results of water balance modelling to evaluate the potential impacts on reliability of the water management system if a new 250 gallon per minute (gpm) Water Treatment Plant (WTP) with the ability to operate continuously throughout the year is used to replace the existing WTP at the Site. The current WTP treats mine-affected water from the Site at a rate of approximately 500 gpm on a 24-hour per day, 4-day per week basis (at an average weekly rate of approximately 286 gpm), but only operates seasonally, typically from March through the beginning of November. The design presented in the Remedial Action (RA) Basis of Design Report (BODR) (MWH, 2015) included construction of a new 500 gpm capacity WTP with the ability to operate continuously throughout the year, to replace the existing WTP. Newmont Mining Company (Newmont) has requested that Stantec Consulting International, L.L.C. (Stantec) evaluate the potential effects of constructing a smaller WTP, that is more compatible with the anticipated longer-term flows at the Site, to replace the existing plant.

BACKGROUND

As part of the RA design, water balance modelling of the water management system during RA construction at the Site was prepared by MWH (now part of Stantec) and presented in Appendix E of the 100% BODR (MWH, 2015). Water balance analyses were performed at key points in time throughout the RA construction in order to account for the effects of changing influent flows to the system over time as portions of the Site are cleaned up and surface water runoff from these areas can be released from the Site without collection and treatment.

The main influent water sources and components of the water management system at key points (Phases) during construction are shown on schematic figures in Appendix E and are included as Attachment 1 to this memorandum. In addition to the WTP, a key component of the Site water management system are storage ponds that provide ability to store influent flows that exceed the WTP capacity during high flow periods, as well as for storage of influent flows during plant upset periods or plant shutdown for routine maintenance or unanticipated conditions. During the initial Phase of RA water management at the Site water is treated at the existing WTP and water storage during plant shut down, high flow, and upset periods is provided by Pit 3. During the next phase of construction, Pit 3 backfilling commences, and the pit is no longer available for storage of impacted Site waters. Water collected during this second phase of construction will be treated at either at the existing WTP or at the new WTP, and water storage will be provided by the South Pond which will be excavated in the southern portion of the South Waste Rock Pile (SWRP).

During this next phase when water is stored in the South Pond, the majority of Mine Impacted Areas at the Site will be cleaned up and the flow volumes reporting to the water management system during the peak spring runoff season are anticipated to decrease by approximately 60 percent due to the reduction in the size of mine-impacted area. The period of time during which the South Pond will be used is expected to begin in early June 2020 and continue until the end of October 2023 (approximately 3.5 years duration), as described in the Appendix X - Remedial Action Schedule of the Remedial Action Work Plan (RAWP, 2018 update). While the actual schedule might vary due to issues associated with the final resolution of the background based cleanup limits, the duration during which the South Pond will be used for storage is expected to remain the same.

As currently designed, the South Pond will have an effective storage capacity (excluding dead storage in the pond bottom) of 63.8 million gallons (Mgal). The storage pond sizing criteria (consisting of an assumed complete WTP plant shutdown occurring continuously during the peak 6 week, 100-year spring meltoff event) was originally developed in 2012 for evaluation of storage capacity requirements for potential water management ponds located in drainages downstream of the major mine affected areas (MWH, 2012). At that time, the earthwork designs and construction schedule for mine waste cleanup had not yet been prepared, and it was assumed that it might be necessary to handle the entire pre-RA water management flow for a 10 to 12-year duration of RA construction activities. Assuming annual metlfoff events are independent, the likelihood of a 100-year meltoff event occurring within that 10 to 12-year timeframe was estimated to be 10 to 11 percent using the following formula:

$$P_N = 100\ [1 - (1-P)^N]$$

Where:

P_N – is the probability of a selected event of interest with an annual probability of P occurring at least once within an N year time interval (expressed as a percentage).

P – is the probability of a selected event occurring within any given year as a decimal fraction (e.g. the 100-year event would have a probability of 0.01)

N – is the length of the time interval of interest in years.

In addition, the timing for construction and commissioning of a new water treatment plant had not been defined during the initial 2012 storage pond evaluation and it was assumed the existing water treatment plant could be operating for most of that period. Given the age of the existing water treatment plant and potential difficulty in obtaining replacement parts for some critical equipment, a six-week shut down period was selected as a reasonable maximum duration shutdown event that could be expected to occur during RA construction. This six-week shutdown was very conservatively assumed to coincide with the pre-RA construction 100-year spring meltoff event.

It should be noted that given the current construction schedule, the assumption that a six week continuous water treatment plant shutdown would occur during a pre-RA 100-year spring meltoff event is considered to be extremely unlikely during South Pond operation given the water management flows are expected to decrease by 60% by the end of the 3.5 year period during which the South Pond will be used. Using the formula presented above, the likelihood of a 100-year pre-RA meltoff event occurring within the 3.5-year construction period during which the South Pond will be used, is approximately 3 to 4 %, after which, the water management flows are expected to reduce significantly as described above. A 30-year meltoff event occurring within the critical 3.5-year construction period would have a similar likelihood (11 %) as a 100-year event occurring within the initially assumed longer (10 to 12 -year) duration. In addition, an assumed continuous six-week plant shutdown duration is considered to be excessively long due to the increased reliability and better availability of key replacement parts for a newly constructed and commissioned water treatment plant.

Water will be stored in the newly construction West Pond during abandonment of the South Pond and cleanup of the remaining mine waste in the vicinity of the South Pond and Pollution Control Pond in the

Central Drainage south of Pit 3It is anticipated that the West pond will be used for approximately 1.5 years prior to completion of the RA work. As discussed in the BODR, the West Pond final design cannot be completed at this time as it is located in the Western Drainage under the current SWRP footprint. The final sizing and design of the West Pond will be completed once the waste rock in the Western Drainage has been removed and the underlying soils meet cleanup limits.

The flows reporting to the water management system are anticipated to further decrease as construction is completed, with the remaining water treatment volumes associated with relatively steady-state groundwater inflows to the pits, alluvial groundwater collection systems, and potentially from miscellaneous seeps (combined flow estimated to be approximately 50 gpm). As such, the current water treatment plant, with a capacity of approximately 500-gpm will be dramatically oversized relative to the anticipated longer-term water management flows.

UPDATED WATER BALANCE FOR 250-GPM WATER TREATMENT PLANT

For the evaluation summarized in this memorandum, the water balance model from 100% BODR was updated to consider the effect of 250 gpm WTP on the ability of the water management system to store water during high flow and upset conditions. A 250-gpm plant is considered to be better matched to the anticipated medium- and longer-term water management flows at the Site. By better "right sizing" the new WTP, the plant will be more efficient in treating water, will have a smaller footprint, resulting in less resources and materials necessary for construction. A plant that more correctly matches longer-term flows will also be able to operate more continuously and result in better scheduling and retention of WTP staff due to the reduced amount of down time for the WTP and personnel.

In general, the flow systems analyzed at the key point in construction (i.e. the start of backfilling of Pit 3 when the South Pond added to the system and when water management flows are highest) are similar to those shown in the schematics for Phase 2 from the 100% BODR included as Attachment 1. The exception being that under the current construction schedule, the alluvial ground water collection systems in the Western Drainage, Central Drainage, and Far East Seep Drainage are not anticipated to completed until later in the project due to the need for cleanup and verification of soils and sediments prior to construction. Therefore, flows from these systems are assumed to not report to the water management system until later when the West Pond is used for storage and are not included in the South Pond water balance.

As with previous analyses, the 250-gpm water balance model relied on historical Site water management records from 1996 to 2014 and made statistical inferences of storage requirements for various shut down requirements. The results of these analyses are included in Attachment 2 and summarized in below.

SOUTH POND INITIAL STORAGE REQUIREMENTS

As described previously, operation of the South Pond will commence with the start of backfilling of Pit 3 as part of RA construction. The South Pond is expected to be used for water storage for approximately 3.5 years. RA construction activities during this phase will include completion of backfilling and capping of Pit 4, and completion of mine waste excavation and soil cleanup in the Western and Eastern Drainages at the Site. Over the course of this phase of construction, the flows reporting to the water management system are anticipated to decrease substantially (by approximately 60%). The results of water balance analyses for the initial (highest inflow) conditions of South Pond operation are summarized in Table 1. For illustrative purposes, the water storage requirements are summarized for average inflow recurrence intervals ranging from 2 years (with a probability of 91% during a 3.5-year period) to 100 years (3% probability of exceedance in 3.5 years). In addition, the storage requirements for assumed WTP shutdown periods ranging from 0 to 6 weeks are shown.

Table 1 – Initial South Pond Storage requirements with 250-gpm WTP

	Probability of Inflow Exceedance During South Pond Operation (%)	Storage Requirements (Mgal) for WTP Shutdown Duration Shown			
		0 weeks	1 week	2 weeks	6 weeks
Inflow Recurrence					
2 years	91	8.3	14.1	16.3	20.4
10 years	31	25.5	34.6	37.4	42.7
20 years	16	32.1	42.5	45.5	51.3
30 years	11	35.9	47.1	50.2	56.2
100 years	3	47.0	60.4	***63.9***	***70.7***

South Pond Effective Capacity = 63.8 Mgal

These results indicate that even during the initial high-flow conditions, the South Pond as designed, in conjunction with a 250 gpm WTP would have the capacity to store water during events as large as a 6-week WTP shutdown during the 30-year meltoff event, or approximately 2 weeks for the 100-year meltoff event. By the end of the 3.5-year Phase 2 construction period, the South Pond will have capacity well in excess of what would be needed to store events greater than a 6-week shutdown of the plant during the peak 100-year meltoff.

LONG-TERM (POST RA CONSTRUCTION) STORAGE REQUIREMENTS

Once remaining waste in the Mine Impacted Areas has been placed in Pit 3 and the Waste Containment Areas having been capped, it is expected that only groundwater inflows to the pits, alluvial groundwater collection systems, and potentially from miscellaneous seeps will report to the water management system. It is anticipated that the flowrates from these sources will be relatively steady and have a combined flow rate of approximately 50 gpm (MWH, 2015). These lower long-term flows, while smaller than the capacity of the proposed 250 gpm plan, can be treated in a more efficient and effective manner than would occur with a 500 gpm plant.

CONCLUSIONS

Based upon the results of the water balance analyses assuming a 250-gpm WTP operating year-round, the water management system utilizing the South Pond for Storage will have sufficient capacity to handle high-flow, shutdown, or other upset conditions. Result indicate that even under the critical short-term initial (high flow) configuration at the beginning of Pit 3 backfilling, the water management system will be able to handle excess flows during a 2-week continuous water treatment plant shutdown that coincides with the peak of the

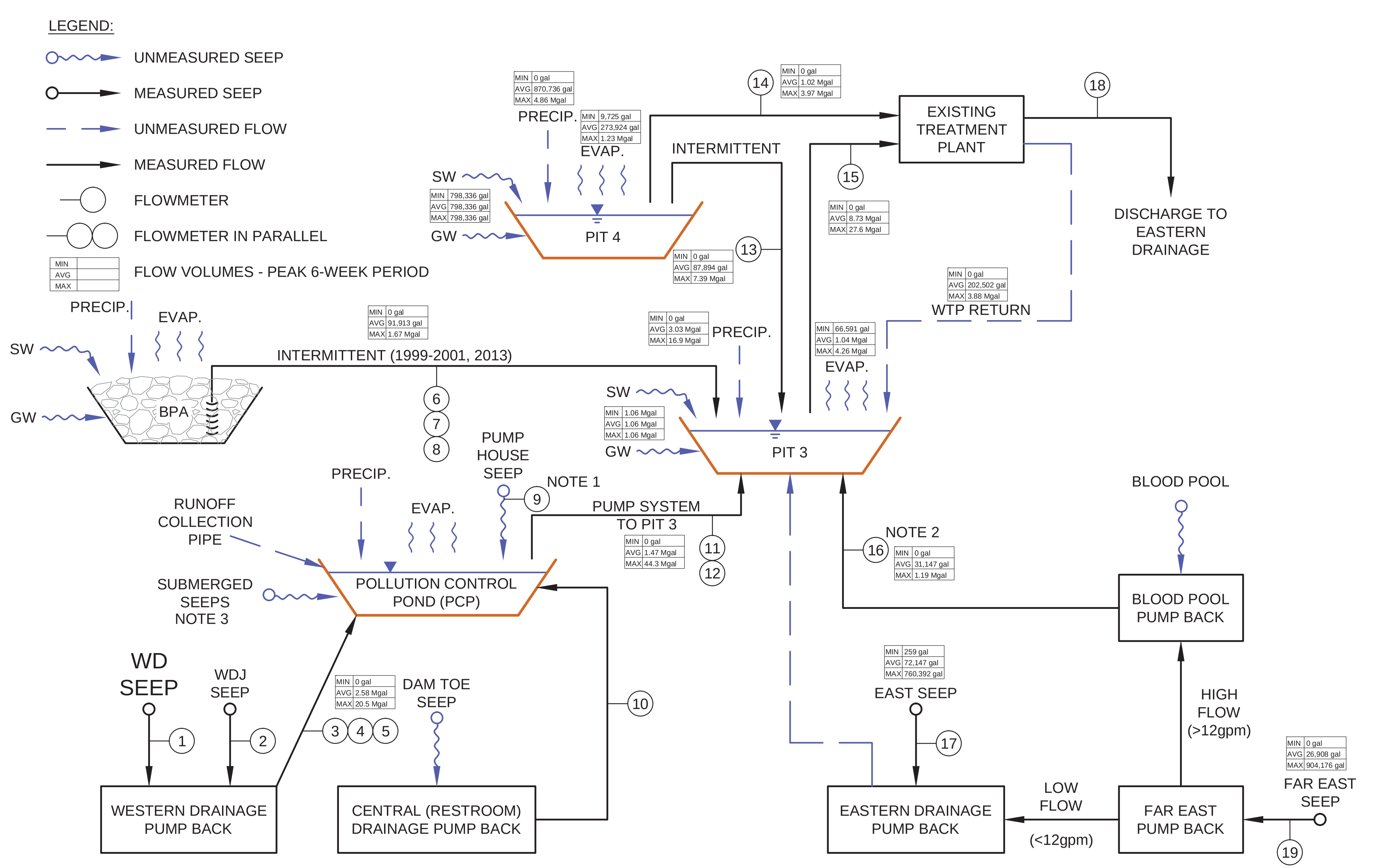
30-year spring snowmelt. These criteria are considered to be very conservative, but more reasonable for pond sizing than the previously assumed 6-week shutdown over during a 100-year meltoff event. However, since these criteria are a modification to those used previously for evaluation of water balance analyses presented in the 100% BODR, it will require preparation of an Engineering Change Notice for submittal to the US Environmental Protection Agency for review and approval before it can be adopted for evaluation of WTP capacity.

Given that flows to the water management system are expected to decrease with ongoing RA construction, and eventually decrease to an estimated rate of approximately 50 gpm, a 250 gpm plant is expected to provide a better match to long term flows while still providing an acceptable capacity to avoid release from the storage ponds during construction.

As discussed in the BODR, the final design of the West Pond cannot be completed until waste rock has been removed from the pond area in the Western Drainage. Final sizing and design of the West Pond will be completed once the waste rock has been removed and the underlying soils cleaned up to provide a better understanding of the resulting topography.

Attachments: 1 – Water Management System Schematics from 100% BODR (MWH, 2015)
2 – Storage Capacity Recurrence Interval Results from Water Balance Analyses

Attachment 1 – Water Management System Schematics



NOTE:
1. NOT MEASURED AFTER 2004.
2. NOT MEASURED PRIOR TO 2010.
3. NOT MEASURED PRIOR TO JULY, 2011

NEWMONT

PROJECT
MIDNITE MINE

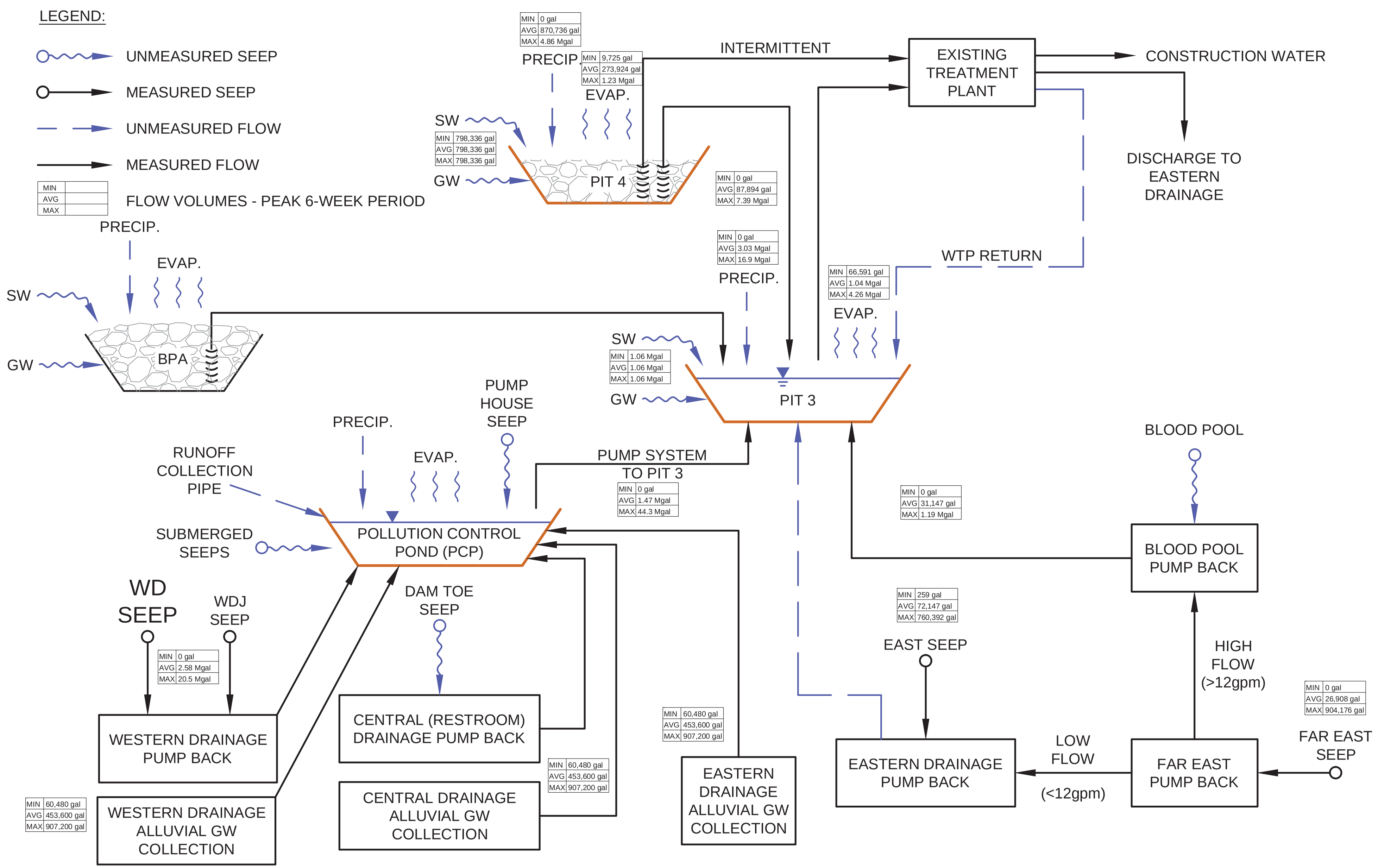
TITLE
WATER BALANCE SCHEMATIC
FLOW DIAGRAM FOR CURRENT
CONDITIONS

MWH

DATE
JULY 2014

FIGURE 1

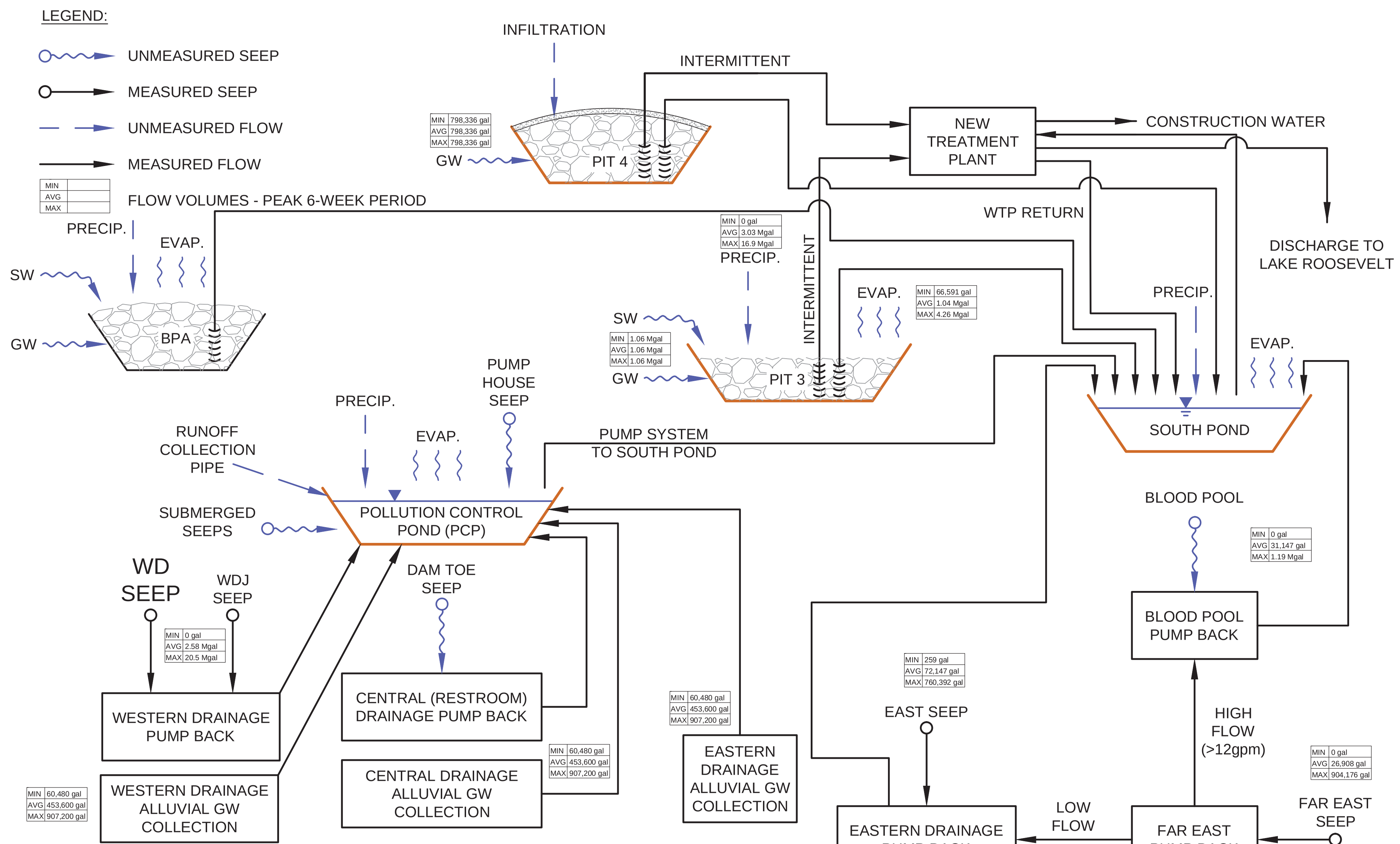
FILE NAME
MM_Schematics_90% Design



NOTE:
1. PIT 4 WILL BE DEWATERED, AND BACKFILLED WITH MINE WASTE IN PHASE 1.

NEWMONT	PROJECT MIDNITE MINE		MWH
	TITLE WATER BALANCE SCHEMATIC FLOW DIAGRAM FOR PHASE 1	DATE JULY 2014	FIGURE 2
		FILE NAME MM_Schematics_90% Design	

\\usslc1s01\FO\Industrial Projects\MIDNITE MINE\Deliverables_Working Documents\Basis of Design Rpt\Appendix E – Water Management Ponds\90% Submittal\Att E-1 Water Balance\Schematics\MM_Schematics_90% Design



NOTES:

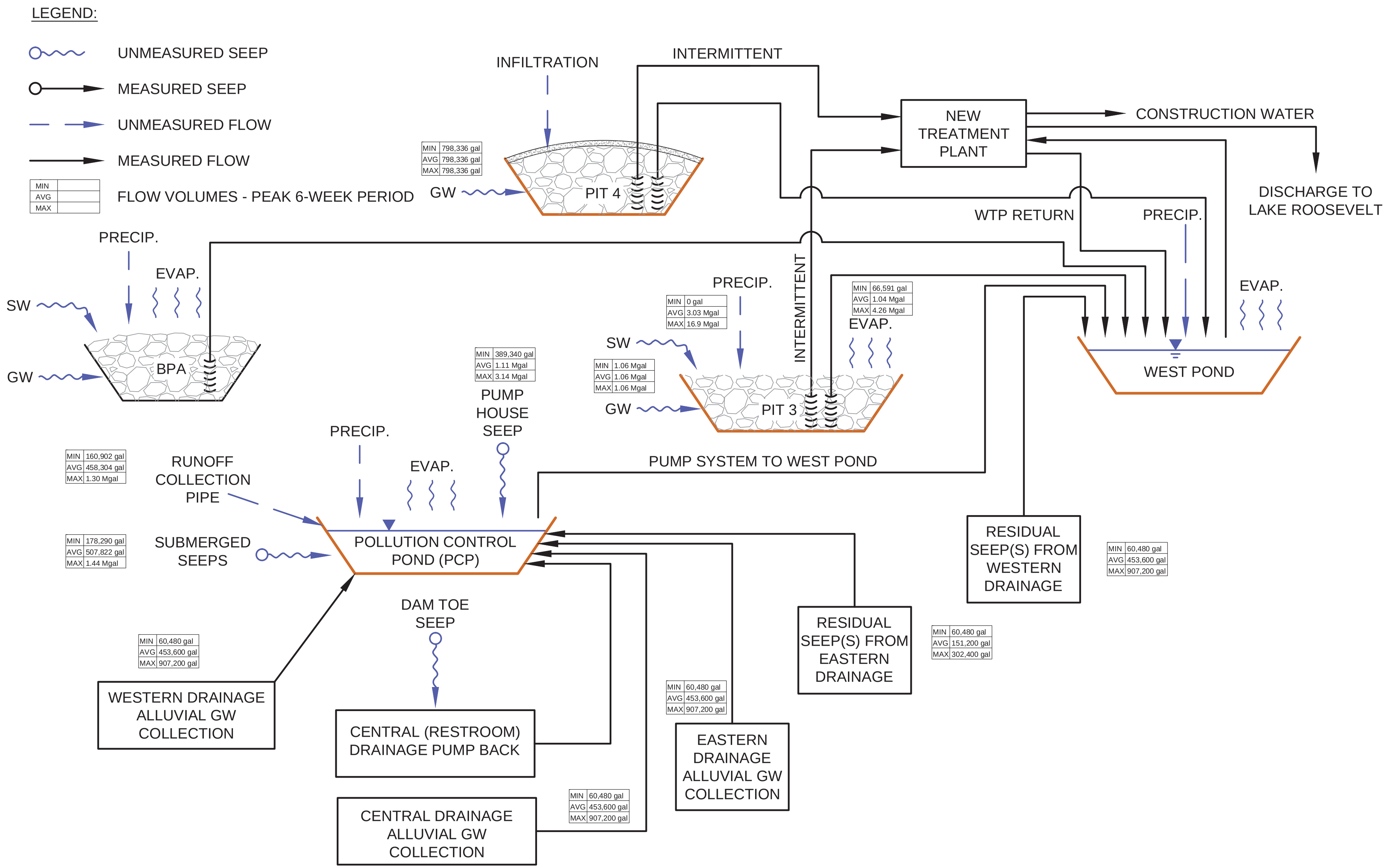
1. THE NEW WATER TREATMENT PLANT WILL BE ONLINE AT THE START OF PHASE 2.
2. PIT 4 WILL BE COVERED AT START OF PHASE 2.
3. SOUTH POND WILL BE IN OPERATION AT THE START OF PHASE 2.
4. PIT 3 WILL BE DEWATERED, AND BACKFILLED WITH MINE WASTE IN PHASE 2.

NEWMONT

PROJECT	MIDNITE MINE
TITLE	WATER BALANCE SCHEMATIC FLOW DIAGRAM FOR PHASE 2

MWH

DATE JULY 2014	FIGURE 3
FILE NAME MM_Schematics_90% Design	



NOTES:

1. SOUTH POND WILL BE DECOMMISSIONED AT START OF PHASE 3.
2. WEST POND WILL BE IN OPERATION AT START OF PHASE 3.
3. PIT 3 WILL CONTINUE TO BE BACKFILLED WITH MINE WASTE IN PHASE 3.

NEWMONT

PROJECT
MIDNITE MINE

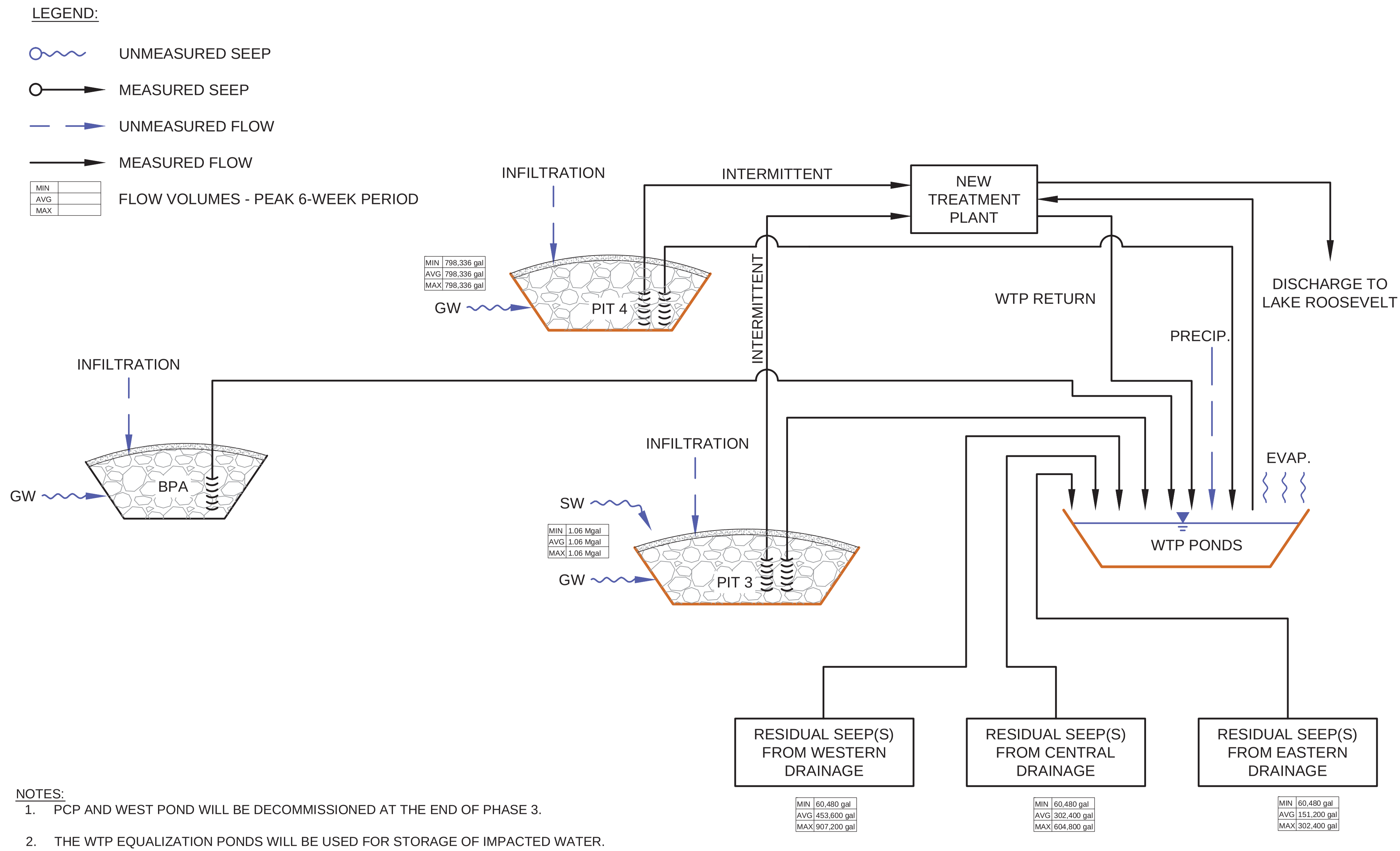
TITLE
WATER BALANCE SCHEMATIC FLOW DIAGRAM FOR PHASE 3

MWH

DATE JULY 2014

FIGURE 4

FILE NAME MM_Schematics_90% Design



NOTES:

1. PCP AND WEST POND WILL BE DECOMMISSIONED AT THE END OF PHASE 3.
2. THE WTP EQUALIZATION PONDS WILL BE USED FOR STORAGE OF IMPACTED WATER.

NEWMONT

PROJECT
MIDNITE MINE

TITLE
WATER BALANCE SCHEMATIC FLOW DIAGRAM FOR FUTURE CONDITIONS

MWH

DATE
JULY 2014

FIGURE 5

FILE NAME
MM_Schematics_90% Design

Attachment 2 – Water Balance Storage Recurrence Interval Estimates

Recurrence Interval (yrs)	Gumbel b	1 week shutdown	No Shutdown
1.05	-1.113344054	(2,115,867)	-5142370
1.2	-0.583198081	3,682,652	-307352
1.5	-0.094047828	9,032,776	4153778
2	0.366512921	14,070,200	8354168
5	1.499939987	26,467,160	18691208
10	2.250367327	34,675,026	25535228
20	2.970195249	42,548,208	32100176
50	3.901938658	52,739,234	40597828
100	4.600149227	60,375,975	46965622
500	6.213607264	78,023,316	61680623

Recurrence Interval (yrs)	Gumbel b	2 week shutdown	No Shutdown
1.05	-1.113344054	(406,433)	-5142370
1.2	-0.583198081	5,557,269	-307352
1.5	-0.094047828	11,059,802	4153778
2	0.366512921	16,240,728	8354168
5	1.499939987	28,990,840	18691208
10	2.250367327	37,432,523	25535228
20	2.970195249	45,529,989	32100176
50	3.901938658	56,011,328	40597828
100	4.600149227	63,865,616	46965622
500	6.213607264	82,015,677	61680623

Recurrence Interval (yrs)	Gumbel b	6 week shutdown	No Shutdown
1.05	-1.113344054	2,772,627	-5142370
1.2	-0.583198081	9,072,326	-307352
1.5	-0.094047828	14,884,875	4153778
2	0.366512921	20,357,696	8354168
5	1.499939987	33,826,155	18691208
10	2.250367327	42,743,446	25535228
20	2.970195249	51,297,126	32100176
50	3.901938658	62,368,988	40597828
100	4.600149227	70,665,791	46965622
500	6.213607264	89,838,434	61680623